1.0 General Information

Motorola has been contracted by Glacier County MT. to provide master site hardware and software required to operate the Northern Tier and Lewis & Clark County, MT. VHF ASTRO 25 trunked radio system. It is the intent of this document to describe the master site equipment and functionality summary. The Glacier County master site equipment will be installed at Lewis & Clark County's Law Enforcement Center (LEC) in Helena, MT.

Motorola provides facility guidelines and recommendations for optimum installation and operation of radio systems in the Motorola document "Standards and Guidelines for Communication Sites" (R56). This document is based on a compilation of industry standards including IEEE, NEC, and TIA / EIA. It details the requirements and expectations for facilities which will be used to house radio communication systems. These requirements include guidelines for grounding, transient voltage surge suppression (TVSS), power, environmental, and physical spacing, all of which need to be addressed to ensure optimum operation of the radio system.

Motorola has provided the master site equipment room power and space requirements, and heat loading information under separate document: "Power and Space Requirements", delivered to Glacier County on April 5th , 2006.

1.1. Project Identification

Identifying Name	Glacier County, MT. ASTRO 25 Master Site
Customer or Buyer	Glacier County
Customer Address (for correspondence)	Northrop Grumman 2401 Colonial Drive Helena, MT 59601
Customer Contact	Tom Olsen (406-443-8404)
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1.2 Revision History

| Date	Version	Author	Description
04/11/2006	1.0	John Scherner	Original Document

2.0 Master Site Description

The master site equipment consists of computer and server equipment, called the "Netra" platform, and manufactured by Sun Microsystems. The Netra platform provides a complete single solution to meet all ASTRO® 25 system frequencies. The Sun Netra™ 240 rack-mounted server offers high availability and expanding features and is part of the Network Management subsystem. The Zone Controller (ZC) for ASTRO® 25 system release 7.1 is called the MZC 5000.

The Netra platform offers:

- **System Availability** - the zone controller allows software upgrades (once loaded) to be operating in approximately two and a half minutes

- **Intelligent switchover - t**he redundant configuration provides automatic switchover to the standby sever if a loss of wide area communications is detected. Notification can be sent to the user if other components fail, allowing the user to manually switch to the standby server if desired

- **Cross-controller compatibility - c**apable of running two different versions of software simultaneously, ensuring that upgrades are fully functional with one controller before upgrading the second controller.

- **Redundancy - t**he zone controller is a computer platform with dual processors that provide trunking call processing for ASTRO® 25 wide area radio communication systems. The redundant zone controller is designed to detect failures by automatically switching operation to the standby controller, minimizing interruption of call processing functionality.

Figure 1 on the following page illustrates the network management servers and zone controllers in relation to an ASTRO® 25 master site.

Figure 1 - ASTRO 25 Master Site System Diagram
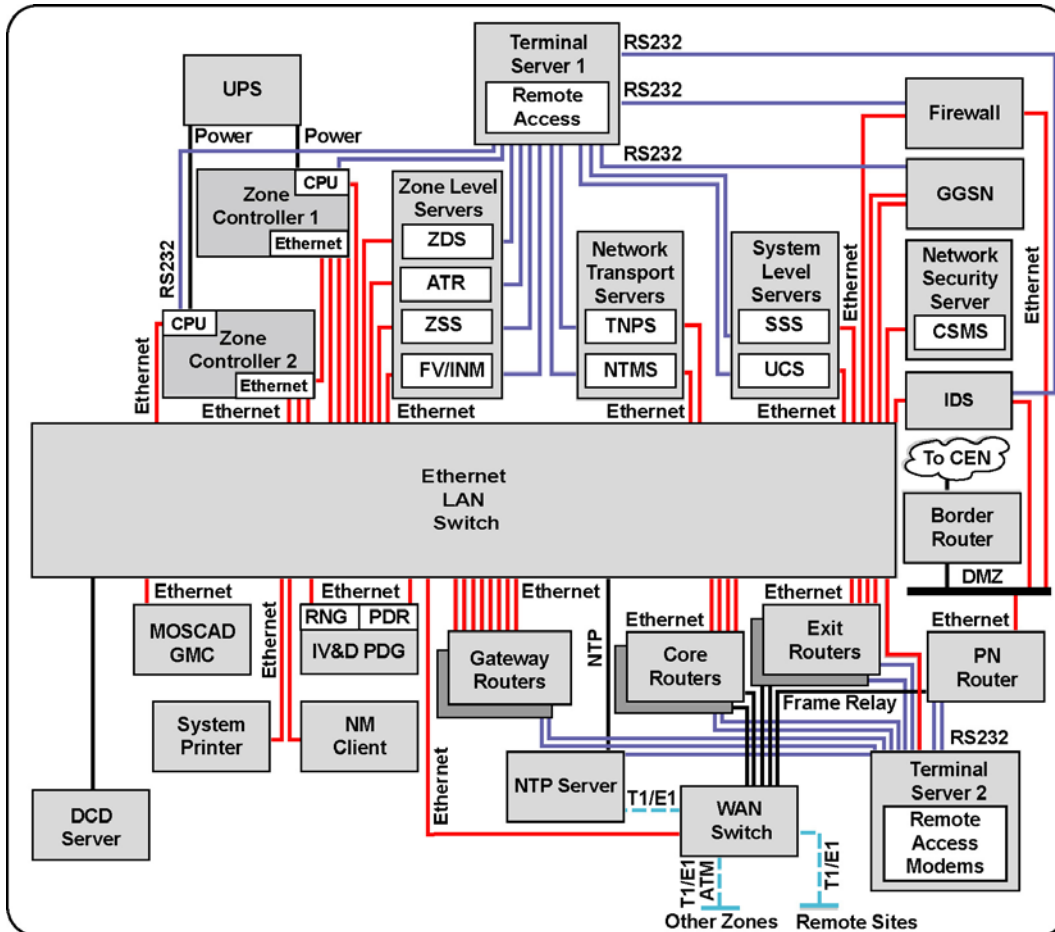
NOTE: MOSCAD GMC alarm central, System Level Servers (SSS), IV&D PDG mobile data, Border Router, IDS, and GGSN data equipment is NOT part of the Glacier County ASTRO 25 Master Site equipment

2.1 Network Management System Servers

The network management subsystem is made up of the servers and other components that combine to form the Motorola Private Radio Network Management (PRNM) Suite. This subsystem is comprised of the software and infrastructure required for user management, system management, fault management, and performance management.

The PRNM subsystem is comprised of the following servers at the zone level of the system.

Zone Level Servers

- Air Traffic Router (ATR)
- Zone Database Server (ZDS)
- FullVision® Integrated Network Management Server (FVINM)
- Zone Statistics Server (ZSS)

The network management servers support fault, configuration, accounting, performance, and security management for the infrastructure. The system includes several different servers that maintain configuration and statistical data, collect fault management information, host PRNM applications, and share information with other equipment in the system.

The network management subsystem also includes two digital audio tape (DAT) 72 tape drives, which provides storage capability for ZSS, ZDS, and FVINM. All of these servers are based on identical Netra™ 240 hardware and share nearly identical menus and configuration tasks.

2.2 Zone Level Servers

This section describes the role of the Air Traffic Router (ATR), Zone Database Server (ZDS), FullVision® INM Server (FVINM), and Zone Statistics Server (ZSS) in the radio system.

Air Traffic Router (ATR)

The ATR receives air traffic information from the zone controller, creates Air Traffic Information Access (ATIA) packets, which represent all of the call control traffic that occurs on the system. The ATR measures and supplies statistics to the Dynamic Reports application and broadcasts them as the ATIA data stream on the network. Various clients listen to this data stream to perform their functions. These clients include:

- Netra Zone Servers (ZSS)
- Netra Zone Database Server (ZDS)
- Radio Control Manager (RCM) application
- Optional Zone Watch application, Affiliation Display, and Third-Party Clients

Zone Database Server (ZDS)

The Zone Database Server (ZDS) maintains the infrastructure database for the zone, retains a replica of the current UCS database and home zone map, and exports the subscriber information it received from the UCS to the zone controller. The ZDS also exports the infrastructure information from its database to the zone controller where it is stored as the local infrastructure database. The ZDS also performs all network management and fault management polling of system devices to support the network management clients. The fault management information that the ZDS collects is passed on to the FullVision® INM server.

The ZDS performs the following tasks:

- Hosts the zone configuration database

- Administers the standard and optional applications licenses

- Authenticating network manager users accessing the system

- Performs back-end support services for user applications

- Handles telephone interconnect record processing

- Serves as a secondary NTP server that the system automatically accesses if no response is received from the primary NTP server. Each server's Unix Administration menu includes a Change NTP Server option, which can be used to change ZDS to the primary NTP server.

The Zone Database, located on the ZDS, contains all infrastructure configuration information for a specific zone, along with a copy of the user configuration information replicated from the UCS. The Zone Infrastructure Database, also located on the ZDS, is simply a copy of the Zone Database.

FullVision INM Server (FVINM)

The FullVision® INM server, also called the Fault server, provides fault management for the system. This server hosts the FullVision® INM and FullVision Web applications, along with FullVision® INM scans system-level and zone-level configuration information to monitor the health of system and zone-level objects, such as servers, zone controllers, and sites.

FullVision® INM derives a listing of system objects from data on the ZDS. Traps and polled device status information from all managed devices is sent from the ZDS to the FullVision® INM server.

To access status, alarm messages and other fault management information that the FullVision® INM server obtains from the ZDS and other IP-managed devices, you can use the FullVision® INM application from a network management client workstation. It provides a centralized view of the operational status of the system by displaying intuitive, graphical representations (subsystem topology maps) of the system. FullVision® INM also maintains a data warehouse, storing up to 30 days of event history for report generation.

Zone Statistics Server (ZSS)

The Zone Statistics Server (ZSS) collects and stores zone-level statistics for the entire zone, including all the sites, channels, talkgroups, and radio users. These statistics are necessary to drive performance reports (Historical Reports and Dynamic Reports). Examples of statistics are number of calls, push-to-talks (PTTs), and busies which are accumulated over preset time intervals. Data can be accumulated on an hourly basis for 10 days, daily for 62 days, and monthly for one year.

The ZSS also acts as the backup server for the zone level servers, providing tape drive administration services for all databases on the ZSS subnet.

2.3 User Configuration Server (UCS)

There is only one User Configuration Server (UCS) per system. The UCS makes it possible for management personnel to configure home zone maps, users, radios, talkgroups, critical sites, Adjacent Control Channels (ACC), security information at a system-level, and other system-level parameters. This information is configured using the User Configuration Manager (UCM) application and is saved in the UCS database.

The User Configuration Server (UCS) stores information about subscribers, talkgroups, critical sites, Adjacent Control Channels (ACC), InterZone control paths, and user security information at a system level. Group and Unit ID home zone assignments are also made at the UCS level. The UCS provides the benefit of a single point of entry for ease of use, with automatic propagation throughout the system to support distributed call processing.

The current UCS database and the home zone maps are distributed to each Zone Database Server (ZDS) in the system. In this way, an identical copy of the most up-to-date UCS database is available to each zone at all times while at the same time ensuring that there is always an available copy to restore the UCS database should it become necessary.

2.4 Core Services

In addition to the user applications, the NMS performs a number of vital tasks and "core" services essential to its operation and maintenance. Network manager user authentication is one of the core tasks performed in conjunction with the ZDS. Another is the Application Launcher on client workstations from where each user application is started.

The applications available to the user are displayed in a Microsoft Explorer window; the License Manager running on the ZDS "checks out" a user license for the selected and authorized application.

The NMS also time synchronizes the servers using Network Time Protocol (NTP) time synchronization. The ZDS serves as a secondary master clock if the primary, GPS-based reference at the master site is not available. Since the servers are interdependent, a Database Blocking process notifies users if the database is being shut down, for example for required maintenance, and terminates any open sessions.

The NMS provides the capability to backup each database to DAT-format tapes. Since the UCS database is replicated in each ZDS, the system includes an application to rebuild the UCS database from the ZDS, thus providing an automatic backup of the user configuration database.

2.5 MZC 5000 Zone Controller Overview

The MZC 5000 is responsible for processing calls, managing audio paths, controlling zone infrastructure, and providing services to subscribers and console operators. The ZC directs and controls most of the components in the zone. A zone consists of the following hardware:

- MZC 5000 zone controller (2 servers for redundancy)
- Ethernet switch
- Ambassador Electronics Bank (AEB)
- Wide Area Network (WAN) switch
- Console subsystem
- Network transport servers and various routers (gateway, core, and exit) used for control and audio information

The ZC is a server that interfaces with other devices at the master site through its Ethernet ports in the radio system. The ZCs are connected to the network through the LAN switch, which switches system resources between the ZCs and provides high availability call management within the zone. Both servers are powered and enabled at the same time, but only one ZC is actively participating in call processing tasks at any one time (active mode). The other ZC is in standby mode.

System information that is necessary for call processing must be downloaded to both ZCs. The zone controllers include hardware for storing data, controlling zone activities, and communicating with zone resources.

2.6 Netra Platform Server Capacity

The following lists the processing capabilities of the ASTRO® 25 system.

- Maximum of 7 zones per ASTRO® system
- Maximum of 100 'RF sites' Per Zone Controller Sub-System
- Maximum of 28 RF channels per ASTRO® 25 Repeater Site
- 700 Channels per zone
- Transport for InterZone Links - T1
- Transport to Sites - T1 / FT1
- 30 console OPs per remote CEB site
- 400 console OPs per zone
- MGEG (Motorola Gold Elite Gateway)
- Zone Manager with 32 User Sessions per Zone
- Operate RCM on Elite LAN
- 20 LAN Printers per Zone

2.7 Technical Overview

This following details the functionality of the Netra platform server in the ASTRO® 25 communication system, and describes the hardware.

Server Connectivity in the System

Each network management server has an Ethernet connection to the LAN switch and an RS-232 connection to the terminal server. The terminal server connection provides a central access point for administering all the network management servers and other devices in the network. The servers can be administered through a locally connected PC client or a remote PC client through a modem connection.

The LAN switch connections for the servers support various types of traffic flow, such as fault, configuration, accounting, and performance traffic. The UCS, ZDS, and zone controller share critical configuration data across the LAN in processes such as UCS database replication, infrastructure database exports to the zone controller, and zone-wide configuration of devices or diagnostic commands from the ZDS. The LAN connection for the FullVision® INM server supports fault management traffic including polling and traps. The LAN connections for the ATR and ZSS support performance management traffic such as air traffic information, access messages, and statistics.

ATR Server Functionality

The ATR performs the following functions:

- Hosts numerous real-time data processing applications to support user and system applications, including the Affiliation Server, which is the "back-end" of the optional Affiliation Display.

- Processes real-time call transactions (live call data) from the zone controller, as the information source for ZoneWatch and RCM.

- RCM command and status packets to/from the zone controller

- Routes call logging packets from the zone controller to the ZSS and SSS

- Acts as the source of an optional ATIA data stream to third-party applications

- Logs to disk ATIA data for viewing or exporting to a text file

- Hosts the statistics proxy agent for the zone controller as a source for Dynamic and Historical Reports statistics

- Receives configuration data for the Dynamic Shared Services Algorithm (DSSA)

The ATR server's administration menus provide the following functions specifically related to the ATR's role in the Netra platform, in addition to the general administration functions these menus provide:

- ATIA Call Logging Setup (Enable, Disable)

- ATIA Unicast IP Address Configuration (Change IP Address)

- Radio Control Manager Information Export (Single Occurrence or Automatic)

- Route Configuration (Add Route, Delete Route, Display Routes, Change to Default)

Zone Database Server (ZDS) Functionality

The Zone Database, located on the ZDS, contains all infrastructure configuration information for a specific zone, along with a copy of the user configuration information replicated from the UCS. The Zone Infrastructure Database, also located on the ZDS, is a copy of the Zone Database.

For the zone-level servers (ZDS, FullVision® INM, and ZSS), only one tape drive is available. The tape drive is connected to the ZSS and the ZSS provides all backup and restore administrative functions as the zone-level backup server. The system checks for conflicts in using the tape drive. If a backup or restore is initiated while another backup or restore is already in progress, the system prompts the user.

In addition to general administration functions, the ZDS server's administration menus provide the following functions specifically related to the role of ZDS in the network management platform:

- Route configuration (add, delete)

- Database administration, including export Infrastructure Database (manual, automatic), restore UCS database (select zone and initiate), synchronize ZDS database with UCS database (initiate, show replication status)

- Feature Administration (enable features, license manager status, enable/disable voice applications)

FullVision INM Server (FVINM) Functionality

FullVision® INM provides fault management for the system by collecting unsolicited SNMP traps from equipment in the network and periodically polling its managed nodes for status information. The FullVision® INM server hosts:

- **Hewlett Packard® OpenView® (HPOV) Network Node Manager (NNM)**
  The foundation on which FullVision® INM is built, HPOV handles object discovery, topology map generation, and polling.

- **Motorola Router Manager software, integrated with HPOV**
  For managing Motorola network routers.

FullVision® INM manages the system's elements and links in one of two ways. It can use SNMP, if supported by the device, or it can use a proxy agent. An SNMP proxy agent provides SNMP support for devices that do not support their own SNMP agent. Multiple devices can be proxied by one of these agents. The two proxy agents are the Zone Database Server (ZDS) and the MOSCAD SNMP Gateway. The following list shows the high level elements and links managed by FullVision® INM.

- Base radio site

- Motorola Gold Elite Gateway (MGEG) with voice cards and secure cards

- ASTRO® 25 Repeater Site

- Simulcast site

- Call processing subsystem (includes the zone controller)

- Servers

- Switch

- Air Traffic Router to Zone Controller Link

- Motorola Gold Elite Gateway to Zone Controller Link

- Site Control Path Link

- Site Manager Link

- Subsite Manager Link

- Interconnect Audio Path

Zone Statistics Server (ZSS) Functionality

The Zone Statistics Server (ZSS) is the administrator for the tape drive that stores the zone level data backups. The Backup Server Administration menu available from the ZSS console is used for backing up and restoring the three types of zone level databases:

- FullVision® INM

- Zone Database Server (ZDS)

- Zone Statistics Server (ZSS)

User Configuration Server (UCS) Functionality

The UCS provides database storage and back-end processes required for most system-wide functions. Included are the mobile radio records, talkgroup records, and services to automatically distribute and replicate these records in the ZDS for all zones in a system. The UCS is accessible to authorized users from any client PC workstation in a system.

The UCS server's administration menus provide the following functions specifically related to the UCS's role in the Netra platform, in addition to general administration functions:

- Database Administration (UCS database restore)

- Feature Administration (Enable Features, License Manager Status, Enable / Disable Voice Applications)

MZC 5000 Zone Controller Functionality

One of the MZC 5000 servers at the master site is designated as the active zone controller and the other is designated as the standby zone controller. These zone controllers exchange operating modes to maintain system performance and reliability.

When the operating status of a zone controller is in active mode, it supports zone controller functionality. When the operating status of a zone controller is in standby mode it supports backup zone controller functionality.

2.8 System Databases

ASTRO® 25 builds on the concept of a wide area trunked, multiple-zone communications system. A zone contains a number of RF sites connected to a master site, which contains the zone management computers, the zone controller, and the audio switch. Zones are linked together through a high-speed wide area network (WAN) to provide virtually seamless communications throughout the entire system coverage area. This section describes the individual databases as follows:

- **User Configuration Server (UCS) database** — This database contains subscriber configuration data and user configuration data.

- **Zone database** — This database resides on the Zone Database Server (ZDS) and contains system and subscriber information.

- **Zone local database** — This database is a flat text file that resides on the zone controller and contains the infrastructure information for that particular zone.

- **Zone Statistics Server (ZSS) database** — This database is used to summarize and report on usage statistics for the zone.

- **Console Database Manager (CDM) / Alias Database Manager (ADM)** — The databases used with the CENTRACOM Gold Elite Dispatch system.

- **FullVision® INM database** — FullVision INM is the software tool used to analyze alarm and state data for fault and performance management.

- **Air Traffic Router (ATR)** — The ATR gathers statistics about call control traffic on the system from the zone controller and passes the information along to the ZSS. The ATR also generates the ATIA stream used by application such as Zone Watch.

3.0 Cooperative WAN Routing for ASTRO 25 Master Site

The 2nd generation network transport design of the ASTRO 25 system infrastructure allows scalability from a single site to multiple sites. The Cooperative WAN Routing (CWR) architecture interfaces directly with the site links (RF Sites, Consoles, and Network Management). The new architecture enables a truly scalable solution from a single site up to 100 sites. CWR also significantly reduces downtime during upgrades since the equipment within the CWR solution is connected and configured for redundant operation.

The CWR technology is configured to fit into a single rack called the ASTRO Switching-Routing Center (SRC). The SRC will include two fully assembled Gateway routers, two fully assembled Core LAN switches, and two (2) pairs of fully assembled CWR capable Core routers, each with 24 T1 / E1 ports, and configured for redundant operation. This provides up to 48 site / console links in any combination up to the maximum number of 100 sites / console links by adding expansion core router and WAN panel equipment. This architecture allows for expansion sites without the need to decommission any equipment.

<u>END OF DOCUMENT</u>